

Performance of Chokeberry (*Aronia melanocarpa*) in Oregon, USA

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Abstract

A planting of chokeberry [*Aronia melanocarpa* (Michx.) Elliott] was established in 1997, using rooted cuttings, at the North Willamette Research and Extension Center in Aurora, Oregon. The cultivars evaluated were 'Albigowa', 'Darbrowice', 'Egerta', 'Kutno', 'Nero', and 'Nowa Wies'. All cultivars grew vigorously in the planting year. In 1998, there was no fruit harvest due to bird depredation; the plot was netted from 1999-01. Yield in 1999 ranged from 4.4 to 12.4 kg/plant with 'Egerta' producing the lowest yield and 'Nero' the highest. In 2000, yield ranged from 13.0 ('Egerta') to 22.1 ('Kutno') kg/plant and in 2001, from 13.1 ('Egerta') to 24.1 ('Nero') kg/plant. 'Kutno', 'Albigowa' and 'Nowa Wies' did not differ significantly in yield from 1999-2001. Plants were pruned for the first time in winter 2000/01. Berry weight ranged from 2.7 to 2.8 g in 2001, considerably larger than in 1999 and 2000. Percent soluble solids at harvest in 2001 ranged from 15.8 to 18.3 percent. Berries contained from 440 to 574 mg/100g anthocyanin.

INTRODUCTION

Chokeberry [*Aronia melanocarpa* (Michx.) Elliott] has become an increasingly popular fruit product in the USA where it is marketed as Aroniaberry juice. While this species is native to Eastern North America and is a diploid ($2x=34$), significant breeding efforts in Germany and Russia have produced cultivars that are tetraploid ($2x=68$) and have sometimes been designated as *A. mitschurini* Skvortsov et Majjtulina. In Eastern Europe, many health benefits are ascribed to Aronia and there is extensive commercial production of this crop for juice. There were 17,800 ha of Aronia cultivated in the Soviet Union in 1984 (Kask, 1987). However, there is presently little commercial hectareage in North America.

Plants grow 0.5 to 3m tall, depending on site, are deciduous with shiny green leaves that turn bright reds and oranges in the fall, have attractive white flowering clusters in May, and dark blue fruit that can be up to 1cm in diameter (Kask, 1987). Plants are self-fertile with about 15 to 20 berries per cluster. Aronia is cold hardy to about -29°C and is not sensitive to spring frost due to the late flowering time. Aronia has generally been planted at a spacing of 2m x 4m. Optimal production was found when pruning all canes back to 1m every four to five years after the plants became eight to ten years old. Average yield was 5.3 to 7.7 t/ha in the Soviet Union (Kask, 1987).

Fruit are high in sugar (12-20% soluble solids), anthocyanins (560 to 1050 mg/100g fresh weight), have a pH of 3.3-3.7 and 0.7 to 1.2 % titratable acidity (Hirvi and Honkanen, 1985; Kaack and Kühn, 1992; Jeppsson and Johansson, 2000; Oszmianski and Sapis,

1988). The juice color is wine red to dark purple. Aronia juice is popular due to its stability under low pH of juices, fruit wines and soft beverages. Aronia is also reported to have high nutraceutical properties. Rate of nitrogen fertilizer application was positively correlated with vegetative growth and yield; however, a moderate rate of nitrogen (50 kg/ha) was found to maximize the production of anthocyanins per plant (Jeppsson, 2000).

The objectives of this project were to compare the performance of several Aronia cultivars and thus assess their commercial potential for Oregon, USA.

MATERIALS AND METHODS

The Aronia planting was established at the North Willamette Research and Extension Center in Aurora, Oregon on May 15, 1997. The soil was a clay loam with a pH of 5.7. Sawdust and 100 kg/ha nitrogen (16-16-16; N-P-K) were incorporated before planting. Plants were rooted cuttings in 1997 and were spaced at 2m in the row (only a single row was planted). The cultivars tested were: Albigowa, Dabrowice, Egerta, Kutno, Nero, and Nowa Wies. There were four single plant replicates arranged in a randomized complete block design in one planting row. The row was watered with drip irrigation, as required. Plants were fertilized with the equivalent of 22 kg/ha N (42-0-0) in 1997 (half applied in each of June and July), 60 kg/ha P and K (0-20-20) applied in March and 60 kg/ha N (21-0-0, applied half in May and half in June) in 1998 and 1999. In 2000-01, plants were fertilized with 20 kg/ha P and K (0-20-20) and 60 kg/ha N (applied as a triple split in March, April, and May).

The planting was not pruned until February, 2001 when two large canes per bush were removed at crown level plus any canes growing prostrate to the ground. In 2000 and 2001, the number of hours required to harvest the entire planting were recorded. In 2001, bloom date was noted for each cultivar. Fruit were harvested in mid- to late-August of each year based on a visual estimation of ripeness. No fruit could be harvested in 1998, due to bird depredation. The entire planting was netted for bird protection in 1999-01. Data were collected on yield per bush, average fruit fresh weight (50 berry sub-sample per bush), and °Brix (percent soluble solids).

Data were analyzed by analysis of variance by year with means compared using a protected LSD test.

RESULTS AND DISCUSSION

Cultivar affected yield per plant in each year of this study (Table 1). The highest yield was in 'Nero' with 12.4 kg/plant or the equivalent of 22 t/ha in 1999, the third year of the planting, and 24.1 kg/plant (43 t/ha) in year five (Table 1). These yields were considerably higher than reported by others: 1 t/ha (0.44 kg/plant) for three-year-old plants (Jeppsson, 2000); and 5.3 to 7.7 t/ha for mature plantings (Kask, 1987). Cumulative yield was lowest for 'Dabrowice' and 'Egerta' (Figure 1). This was likely related to a significantly smaller plant size (Table 2). Although 'Dabrowice' and 'Egerta' did not have fewer canes per bush than the other cultivars, bush height and width or vigor tended to be lowest on these cultivars (Table 2).

Although we did not collect hand picking efficiency data separately for each cultivar, we recorded an average hand picking efficiency of 7.3 kg per hour in each of 2000 and 2001. We did not test machine harvest efficiency in this study. However, a commercial grower in Oregon has successfully machine harvested Aronia using an over-the-row rotary harvester with the beater speed set high. In our observation, Aronia would benefit from trellising to keep the bush more upright to improve machine harvest efficiency.

In 2001, no difference in bloom time was observed among the cultivars. First bloom was recorded on April 24 with 50% bloom on April 30.

Berry weight was significantly affected by cultivar from 1999-01 (Table 1). Berries were considerably larger in 2001, perhaps due to a more advanced stage of maturity. We may have harvested the fruit too early in 1999, as the percent soluble solids was about 13% and berry weight was low (Table 1). Jeppsson and Johansson (2000)

found that berry weight increased 30% from the time the berries changed color from purple to black. In addition, they noted that anthocyanin content increased 200% from first color change (Aug. 14; 670 mg/l) to September 8 (1980 mg/l). Kaack and Kühn (1992) reported an increase of 30% (from 800 to 1050 mg/100g) in total anthocyanin from color change (purple to black) and five weeks onwards. In our study, total anthocyanin ranged from 440 to 574 mg/100g in 2001, relatively low levels compared to what has been reported in other studies (Kaack and Kühn, 1992; Jeppsson and Johansson, 2000).

We observed no insect or disease pests on any of the cultivars tested. Birds did not eat fruit until after color change. This necessitated netting our test planting. The potential for bird depredation on large plantings is unknown.

Our findings show that this crop is easy to grow in Oregon. Plants were very precocious, but cultivars did differ significantly in yield.

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Tables

Table 1. Yield, berry weight and percent soluble solids of chokeberry (*Aronia melanocarpa*) in 1999-2001 from a planting established in 1997 (from rooted, one-year-old cuttings). N=4

| Cultivar | Yield (kg/plant) | | | Berry weight (g) | | | Soluble solids (%) | | |
|--------------|---------------------|---------|---------|------------------|---------|----------|--------------------|---------|--------|
| | 1999 | 2000 | 2001 | 1999 | 2000 | 2001 | 1999 | 2000 | 2001 |
| Nero | 12.4 a ^z | 17.9 ab | 24.1 a | 1.13 b | 1.03 c | 2.62 c | 13.0 | 19.5 a | 15.8 |
| Nowa Wies | 11.1 a | 21.6 a | 15.9 bc | 1.13 b | 1.13 bc | 2.69 bc | 13.2 | 16.4 b | 17.8 |
| Albigowa | 10.4 a | 21.6 a | 20.5 ab | 1.22 a | 1.25 a | 2.79 ab | 12.8 | 17.5 ab | 17.5 |
| Kutno | 10.0 a | 22.1 a | 17.3 bc | 1.19 ab | 1.09 bc | 2.72 abc | 13.0 | 16.6 b | 18.3 |
| Dabrowice | 4.8 b | 13.9 bc | 16.5 bc | 1.25 a | 1.16 ab | 2.69 bc | 13.5 | 16.5 b | 16.8 |
| Egerta | 4.4 b | 13.0 c | 13.1 c | 1.22 a | 1.15 ab | 2.82 a | 13.4 | 16.6 b | 16.7 |
| LSD | 2.4 | 4.4 | 6.4 | 0.09 | 0.10 | 0.12 | 1.1 | 2.1 | 1.9 |
| Significance | 0.0001 | 0.0008 | 0.0347 | 0.0283 | 0.0067 | 0.0200 | 0.8123 | 0.0500 | 0.1562 |

^z Means followed by the same letter are not significantly different using a protected LSD (P>0.05)

Table 2. Effect of aroniaberry cultivar on bush size in 2001. The planting was established in 1997 (from rooted, one-year-old cuttings). N=4

| Cultivar | Number of canes per bush | Bush height (m) | Bush width (m) |
|--------------|--------------------------|---------------------|----------------|
| | | | |
| Nero | 27.8 | 1.6 ab ^z | 2.4 ab |
| Nowa Wies | 21.8 | 1.7 a | 2.3 b |
| Albigowa | 24.3 | 1.7 a | 2.5 a |
| Kutno | 19.5 | 1.7 a | 2.4 ab |
| Dabrowice | 17.3 | 1.5 b | 2.1 c |
| Egerta | 20.0 | 1.2 c | 1.9 c |
| LSD | 7.2 | 0.2 | 0.2 |
| Significance | 0.0775 | P=0.0002 | P=0.0001 |

^z Means followed by the same letter are not significantly different using a protected LSD (P>0.05)

Figures

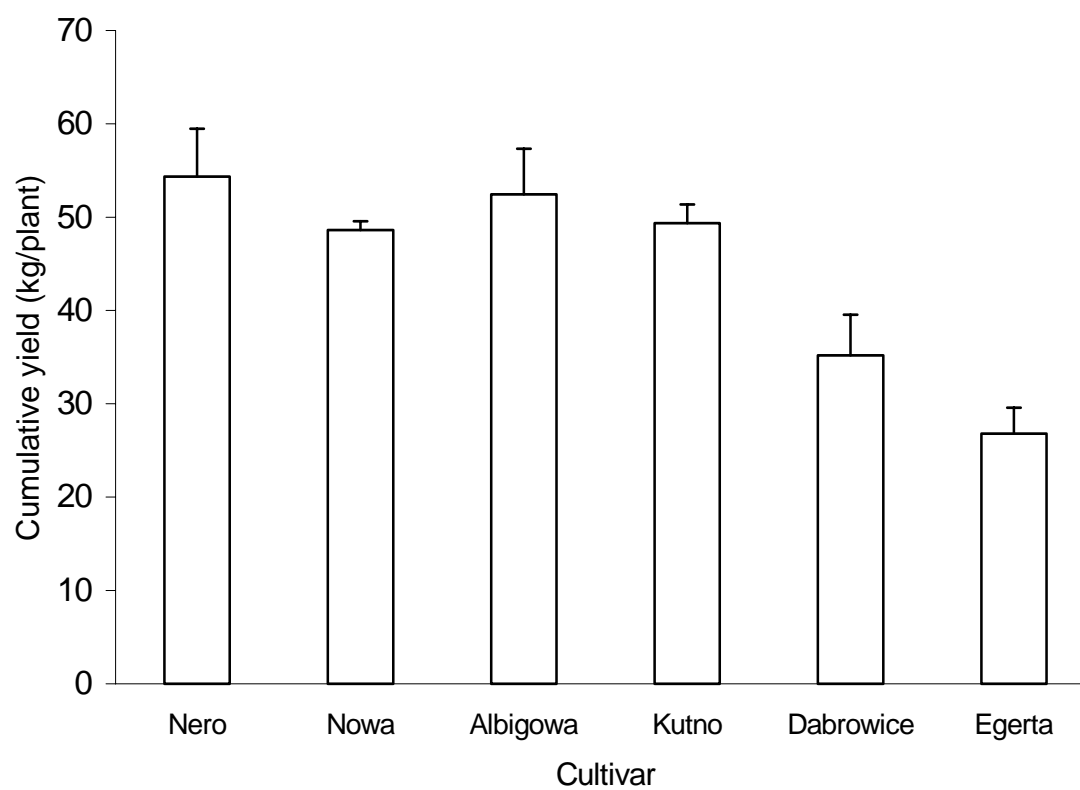


Fig. 1. The effect of aroniaberry cultivar on cumulative yield (1998-01). N=4. Standard errors provided on bars.